Robert Kellner Lecture awarded to ABC author Jürgen Popp

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Jürgen Popp studied chemistry at the universities of Erlangen and Würzburg. After receiving his PhD in chemistry, he joined Yale University for postdoctoral work. He subsequently returned to the University of Würzburg, where he finished his habilitation in 2002. Since 2002 he holds a chair in physical chemistry at Friedrich-Schiller University Jena. Furthermore, he is the Scientific Director of the Institute of Photonic Technology, Jena, since 2006. His research interests are mainly concerned with biophotonics. In particular, his expertise is in the development and application of innovative Raman techniques for biomedical, life science, and environmental analyses should be emphasized. His results have been published in more than 400 scientific articles in premier peer-reviewed journals and he has been named as an inventor on 12 patents in the field of spectroscopic instrumentation. He coordinates the European Network of Excellence Photonics4Life and is Editor-in-Chief of the *Journal of Biophotonics*. Since 2009, he is a Fellow of the Society for Applied Spectroscopy and since 2012 an SPIE fellow. In 2012, he received an honorary doctoral degree from Babeş-Bolyai University in Cluj-Napoca, Romania.

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Professor Jürgen Popp is the recipient of the 2013 Robert Kellner Lecture Award. His lecture, entitled “The many facets of Raman spectroscopy for biomedical analysis,” will be presented at the 17th European Conference on Analytical Chemistry (Euroanalysis 2013), to be held in Warsaw, Poland, from August 25 to August 29, 2013.

The Robert Kellner Lecture, sponsored by Springer-Verlag, is awarded to someone who has made a substantial contribution to the advancement of analytical chemistry research or education. The award was established by the Division of Analytical Chemistry of the European Association of Chemical and Molecular Sciences in memory of the efforts and achievements of Prof. Robert Kellner, Vienna University of Technology, in particular towards the consolidation of analytical chemistry in Europe.

Who is Jürgen Popp?

Jürgen Popp has talked about his research, his motivations, and himself to Andrea Pfeifer.

What is the focus of your award-winning research and what was/is your motivation?

The main focus of my research is biophotonics, that is the development of optical approaches for biomedical diagnostics and life sciences: we are developing innovative linear and nonlinear Raman techniques and multimodal imaging approaches to rapidly identify and characterize biomolecules, bioparticles (such as bacteria, yeasts, and viruses), and biological tissue to address important biomedical questions related to infectious diseases, cancer diagnostics, as well as environmental and food safety. I am dedicated to applications-oriented basic research, such as developing analytical approaches with great potential for clinical

routine diagnostics. In other words, my great motivation is to move biophotonics technologies into routine clinical procedures.

What is the trickiest problem you have had to overcome in that research? How did you solve it?

Our trickiest problem is not a scientific one—it is the challenge of crossing disciplines. Biophotonics is a multidisciplinary field, ranging from physics, engineering, and chemistry, especially physical chemistry, to biology and medicine. Thus, it is crucial to integrate researchers who are experts in more than one field to make possible and foster communication between the different fields to generate novel approaches and avoid “friction losses” or frequent “reinvention of the wheel.” We have successfully strengthened our collaboration with clinicians and other end users by involving them in our research from the very beginning rather than developing nice analytical approaches that turn out to be incompatible with clinical applications. This strategy of “bridging the gap” is also pursued by the European Network of Excellence Photonics4Life that we initiated and coordinate from Jena.

From where did you start and how does your current work relate to/differ from your scientific roots?

I studied chemistry at the universities of Erlangen and Würzburg, and my PhD in physical chemistry was actually on a topic very different from my research today. During my PhD studies in Würzburg, my postdoctoral research at Yale University in the USA, and also my habilitation back in Würzburg, I studied optical processes in microdroplets. During this time, I learned a lot about optical spectroscopy and, in particular, about the unique potential of Raman spectroscopy. Back then, I and various other people realized that the technological advances in photonics, especially in laser and filter technology, could shift Raman spectroscopy from a complicated method with elaborate equipment to an easy-to-handle technique with great relevance/potential for biomedical and life science analyses. In other words, we recognized the unique potential of vibrational spectroscopy to solve biomedical, life science, and environmental problems. Therefore, when I was appointed to a chair in physical chemistry at Friedrich-Schiller University Jena in 2002, I decided that this was the right time to change my research focus towards biophotonics, in particular, towards the design and application of linear and nonlinear Raman-based and multimodal imaging approaches for biomedical, life science, and environmental diagnostics. In retrospect, I think this was the right decision.

How would you explain your current research to a child?

One of our research topics is Raman-based microbial analysis, which can be thought of as operating in a way similar to when a suspect is proven guilty of a crime by his fingerprint. As you know, bacteria can make people very sick; therefore, to cure these people, it is very important to quickly know what kind of bacterium has caused their infection so that the most suitable drug can be chosen to fight it. Unfortunately, this analysis often takes days, whereas our approach can identify the bacterium within several hours. We irradiate the bacterium with a laser, and the laser light is scattered in all directions, leading to a characteristic pattern, which we call an optical fingerprint, of the bacterium investigated. This optical fingerprint is typical of the bacterium, just like a fingerprint is unique to every human being. We collect the optical fingerprints for a huge variety of bacteria and store them in a database. To rapidly identify an unknown bacterium, we proceed much as the police do when identifying a criminal suspect by his or her fingerprint: we take its optical fingerprint and verify it with our database.

Where do you consider your field is heading?

Current advances in ultraresolution microscopy and molecular spectroscopy provide us with a fascinating opportunity to study cellular processes down to the molecular and functional level. This will take us a major step forward in understanding the origins of diseases and allow us to initiate novel methods for their early diagnosis and targeted therapy. Furthermore, I am sure that in a few years we will see many more biophotonic innovations as standard diagnostic or therapeutic tools in daily clinical practice. Biophotonics will also play a major role in environmental monitoring and protection, as well as in food and pharmaceutical safety. Generally, biophotonics will take over a crucial role in providing efficient, sustainable health care worldwide, which is recognized as one of the “grand challenges” of the twenty-first century.

Which recent discovery might prove most valuable to the field of bioanalytical research or beyond?

Rather than a particular discovery, I would like to highlight a complete research area, namely, innovative fiber technology and fiber optical sensing. Various microspectroscopic and spectroscopic approaches have shown great potential for improved medical diagnosis. However, in vivo clinical applications often require their implementation in endoscopic setups.

Here, recent advances in fiber technology, such as fiber-based waveguide optics, microstructured optical fibers, and fiber laser approaches, will prove extremely helpful.

What motivated you to become a researcher and what do you find most rewarding in your professional life?

My motivation to become a researcher came from my PhD adviser, Prof. Wolfgang Kiefer (University of Würzburg), who gave me all the freedom and support I needed to work on my PhD project. During that time, I started to appreciate the freedom you have as a university professor to pursue research projects and to set your own agenda. Currently, I hold a chair in physical chemistry at Friedrich-Schiller University Jena and, in addition, I am the Scientific Director of the Institute of Photonic Technology. I can honestly say that these positions are my dream job. Two aspects of my professional life are highly rewarding. One is the success that comes when a research idea that my team and I developed on a piece of paper or on a chalkboard works out in the laboratory and finally ends up in a nice publication and/or a patent that can be further developed with partners into prototype devices. The other is the experience of interacting with colleagues from other disciplines, such as medicine and biology, and coming up with a nice interdisciplinary project. Of course, as a university professor I also like teaching, and the most rewarding aspect of being a teacher is to confer my

enthusiasm for physical chemistry to young chemistry students.

What is your advice for young analytical scientists today?

My advice for young analytical scientists is not to be put off by the long and often tedious way necessary to pursue a university career. From my own experience, I can say that the effort is worth it.

From your personal point of view, which ABC feature do you like (best) and why?

First of all, ABC has become one of the most important journals in which to publish our results, since it covers a broad range of bioanalytical topics. My favorite ABC feature is Trends articles, which provide interesting insights into where a certain research topic is heading. These five-page articles can be read quickly, which is really helpful in daily routine.

And last but not least, what do you enjoy most when you have time to spare?

This question is very easy to answer because the most important thing in my life is my family, and I enjoy every moment shared with my wife and my four children.